



REMUS: The new CERN Radiation and Environment Monitoring Unified Supervision



ICALEPCS 2015, Melbourne, Australia
Oct 2015 - Adrien Ledoul on behalf of REMUS Team
CERN Health, Safety and Environment Unit



Introduction

Why do CERN needs a new Radiation Protection & Environment Monitoring System?

Radiation Protection and Environment Monitoring at CERN

50 km Accelerator Tunnel - 60 Access Points - 160 Experiments - 8,000 Radiation Workers



Radiation Protection and Environment Monitoring at CERN



Stray Radiation (x43)

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Radiation Protection and Environment Monitoring at CERN

Environment Monitoring:

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Stray Radiation (x43)



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Ventilation (x47)



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Stray Radiation (x43)



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Water (x14)



Radiation Protection and Environment Monitoring at CERN

Environment Monitoring:

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Water (x14)

Many more!



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Radiation Protection:



Gamma Radiation (x46)



Radiation Protection and Environment Monitoring at CERN

Environment Monitoring:



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Water (x14)

Many more!

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ATLAS



CMS



LHC Tunnel



LHCb



ALICE

Radiation Protection:



Gamma Radiation (x46)



Hand-Foot Contamination (x60)



Radiation Protection and Environment Monitoring at CERN

Environment Monitoring:



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Many more!

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Radiation with Alarm Units (x100)



Radiation Protection and Environment Monitoring at CERN

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Radiation Protection and Environment Monitoring at CERN

Environment Monitoring:



Stray Radiation (x43)



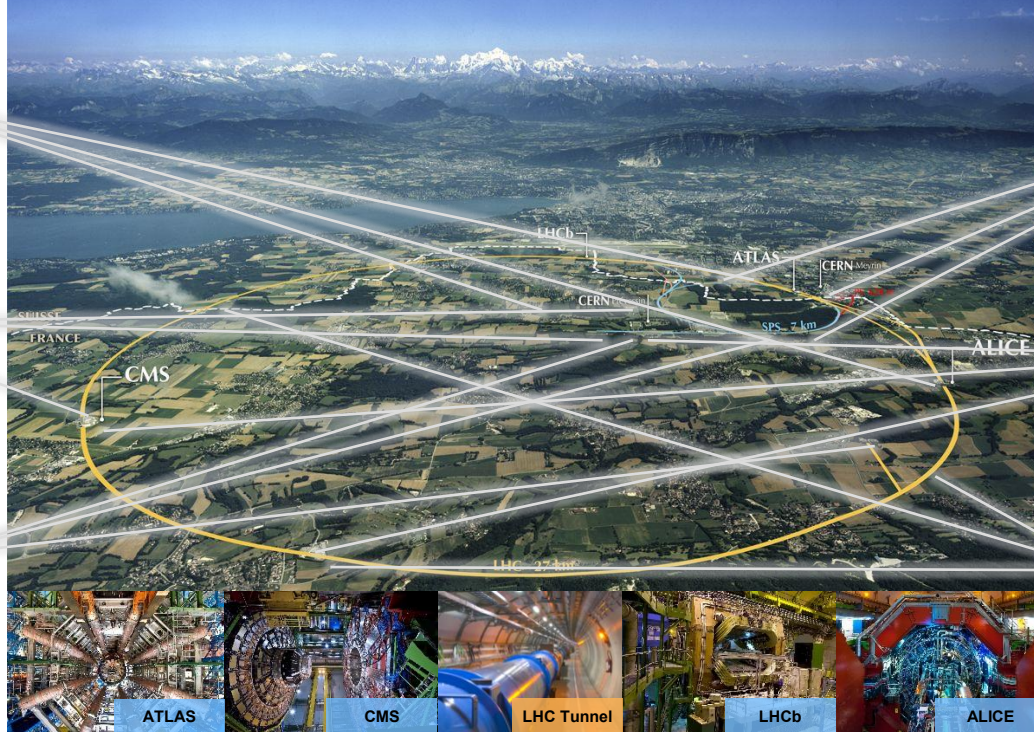
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Many more!



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Environment Monitoring:



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Water (x14)

Many more!

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~500 Monitoring Stations:

- 30 different types
- Commercial Off-the-Shelf & Internally Developed Stations
- Surface and Underground areas

~3,000 Measurement Channels:

- 700 measurements to logging / second

Workplace and Environment Safety

Reporting to authorities:

- Nature and quantities of emitted ionizing radiation
- Conventional environmental measured values



Radiation Protection:



Gamma Radiation (x46)



Hand-Foot Contamination (x60)



Radiation with Alarm Units (x100)

Many more!



Previous Supervisory Systems

- RAMSES - RAdiation Monitoring System for the Environment and Safety (2005)
 - Data Acquisition, Supervision and Control of **1,500** channels
- ARCON - ARea CONtroller
 - Data Acquisition and Control of **300** channels (~1980)
- Proprietary Software (such as Berthold MEVIS)
 - Data Acquisition and Supervision of **100** channels
- Stand-alone devices
 - More than **1,000** channels not remotely supervised



ARCON



Requirements & Scope of the new Supervision: REMUS

- **REMUS - Radiation and Environment Monitoring Unified Supervision**
 - **Data Acquisition, Supervision and Control** of Environment and Radiation Monitoring Stations
 - In **continuous operation** since 2013 (**1,000** channels so far)
 - In 2016: **500** Monitoring Stations - **3,000** Channels - **500,000** Tags
 - 365 days/year, **24/7** operation (**even during shutdowns of accelerators!**)
- **Aims**
 - **Unify** all CERN Radiation and Environment supervisory systems
 - **Reduce delay** and the cost of **adding new devices** to the supervision
 - Provide **light and fast clients, customized** for each user's requirements
 - **Reduce overall maintenance** needs for operation
 - Use CERN **common software & framework** for SCADA:
 - SIMATIC **WinCC OA**
 - CERN **JCOP**(Joint COntrols Project) framework
- **Guideline**
 - **Reliability, Scalability, Performance, Adaptability, Cost-Effectiveness**



RADIATION AND ENVIRONMENT MONITORING UNIFIED SUPERVISION

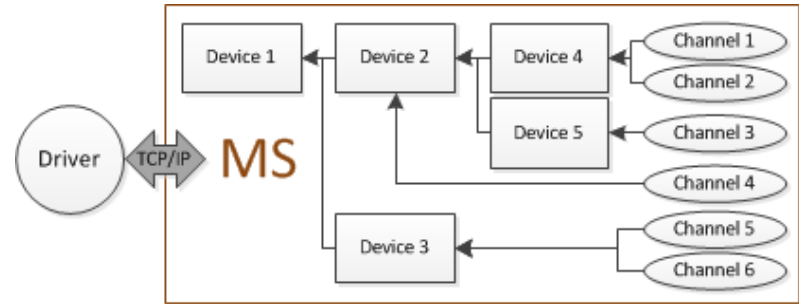


Heterogeneous Device Types

How do REMUS handles heterogeneous Device Types Integration?

Model and Basic Concepts

- **Generic model of instrumentation**
 - 3 basic concepts:
 - **Channel**: One point of measurement
 - **Device**: Piece of equipment, connected to other devices and channels
 - **Monitoring Station (MS)**: Encapsulation of devices and channels
 - All the instrumentation is modelled using those **3 concepts**
- **Advantages:**
 - **Homogeneous** set of equipment
 - **Uniform development** process
 - **Re-usable** source code
 - **Infrastructure Independency**



Run-time Installation of new Devices

- A changing environment

- CERN often **dismantles / moves / installs instrumentation**
- Adding new MS to a supervision typically requires:
 - Software **qualification for each new MS**
 - Server **Restart**

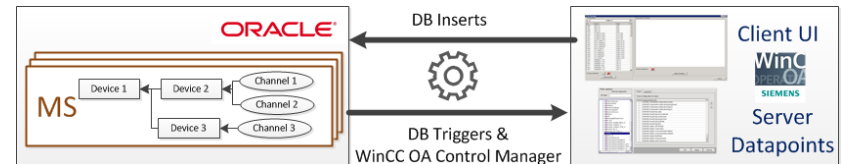


- Abstraction of the complexity

- REMUS allows users that have advanced access rights to **add MS to the system**
- **Instantiation** of model previously defined in an external Oracle DB, used to **creates variables** in REMUS
- The process of **adding a new MS** itself is **qualified**
- This process can be executed during **run-time**

- Advantages :

- A new **Monitoring Station** can be installed in a **few minutes** in REMUS
- **No Server restart** is necessary
- **Low maintenance** effort

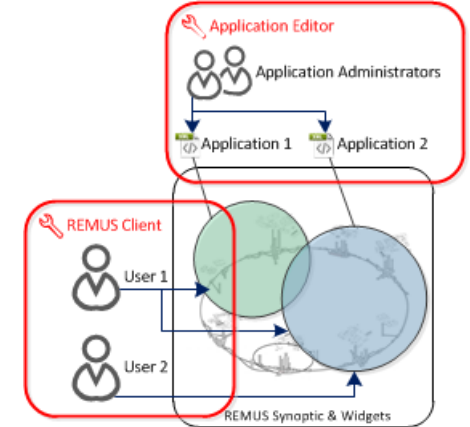


Diversity of Users

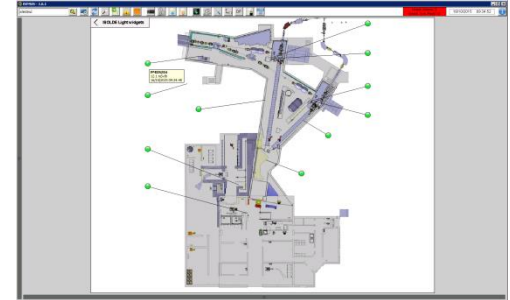
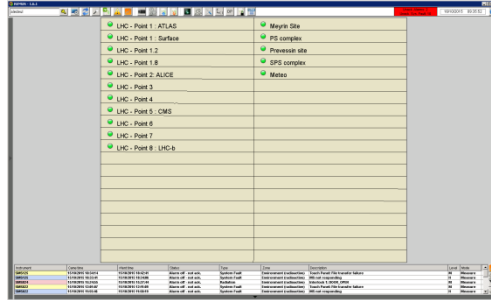
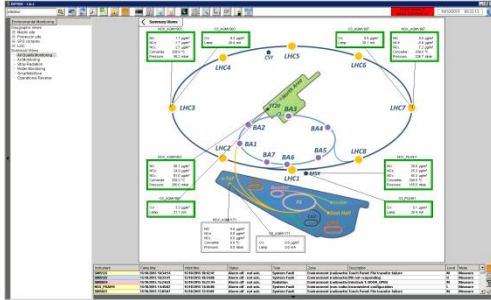
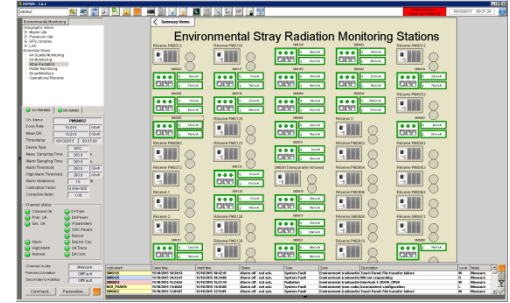
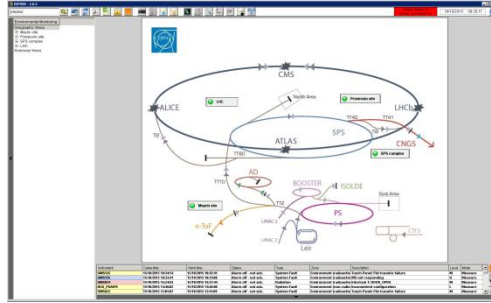
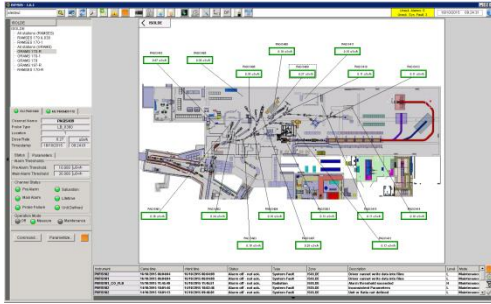
How do REMUS provides customized User Interfaces?

REMUS Applications

- Users have different needs
 - **Many different user profiles** use REMUS (accelerator & experiments operators, radiation protection engineers, environmental engineers, physicists, maintenance teams...)
- Customized User interfaces
 - REMUS is split into several **Applications** (subsets of REMUS instrumentation), with a specific layout (synoptic, widgets):
 - Applications are fully described in **xml files**, editable through a **user friendly editor**
 - Applications can be uploaded/downloaded from the supervision
 - **Advanced Users** (Application Administrators) are able to **modify the layout of the supervision in runtime**
- Advantages
 - Users can focus on the **part of the supervision** they are interested in
 - Improved **Performance**
 - **Distributed maintenance** effort

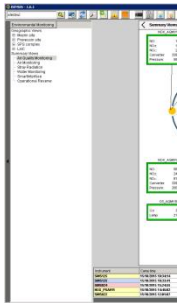


REMUS Applications



REMUS Applications

Created by Radiation Protection and Environmental Engineers!



Project

- Geographic Views
 - Meyrin site
 - Water Release (FR)
 - Water Release (CH)
 - Stray radiation (FR)
 - Stray radiation (CH)
 - Prevesin site
 - Prevesin North
 - Prevesin South
 - SPS complex
 - Stray radiation
 - BA1
 - BA2
 - BA3
 - BA4
 - BA5
 - BA6
 - BA7
 - LHC
 - Point 1: ATLAS
 - Water Release
 - Point 2: ALICE
 - Water Release
 - Point 3
 - Water Release
 - Point 4
 - Water Release
 - Point 5: CMS
 - Water Release
 - Point 6
 - Water Release
 - Point 7
 - Water Release
 - Point 8: LHC-b
 - Water Release
 - Point 1.8
 - Water Release
 - Summary Views
 - Air Quality Monitoring
 - Air Monitoring
 - Stray Radiation
 - Water Monitoring

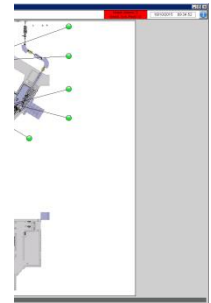
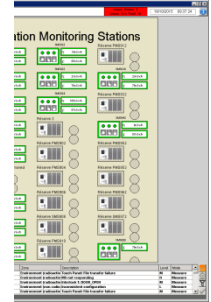
Components Contained

- Equipment: channel 10079
- Equipment: channel 10078
- Label: Réserve PMS072
- Equipment: MS 0
- Equipment: channel 0
- Equipment: channel 0
- Equipment: MS 1056
- Equipment: channel 10081

Properties	Values
category	channel
equipmentId	10081
posX	875
posY	130
targetX	675
targetY	384
version	none
restriction	none
realTimeTrend	<input type="checkbox"/>
disableSummary...	<input checked="" type="checkbox"/>
disableSummary...	<input type="checkbox"/>
valueFormat	
freeText	

synoptic equipment button alarmSummary label line

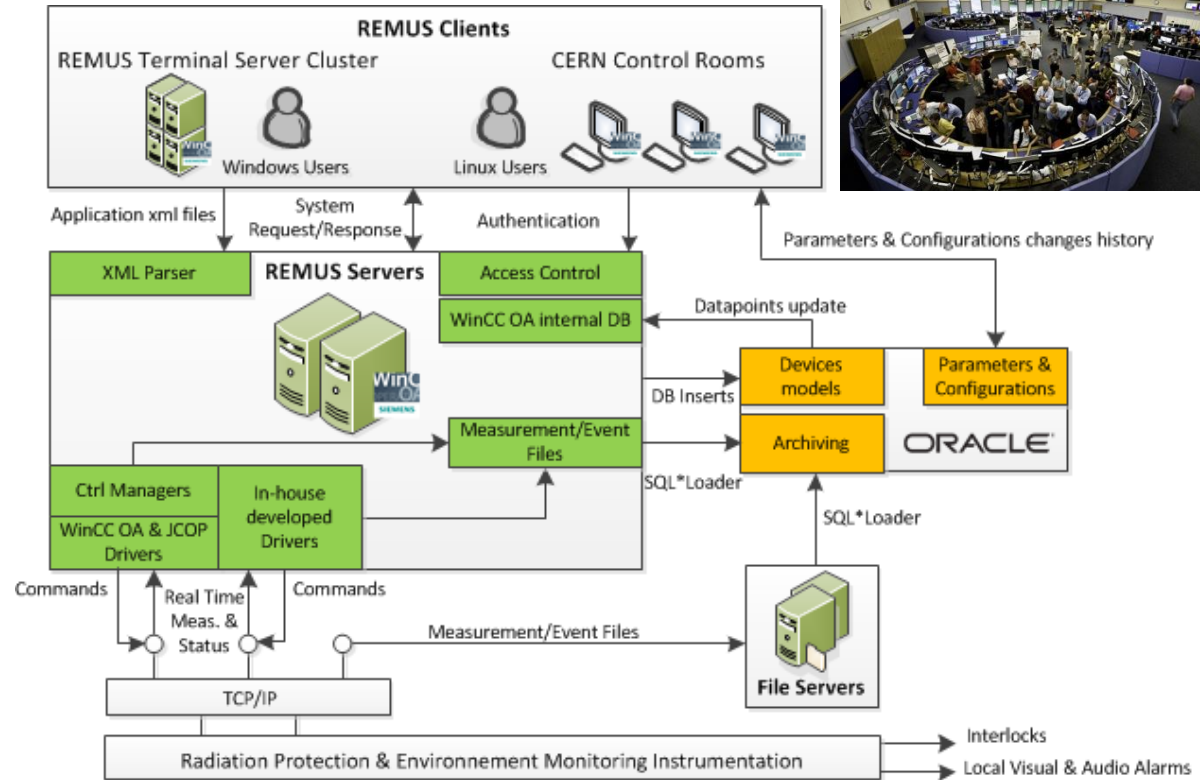
NO:	0.0 µg/m ³	Channel: XXX	location	1: XXX XXX
NO ₂ :	0.0 µg/m ³	Probe type: XXX		2: XXX XXX
Converter:	0.0 °C			
Pressure:	0.0 mbar			



Architecture

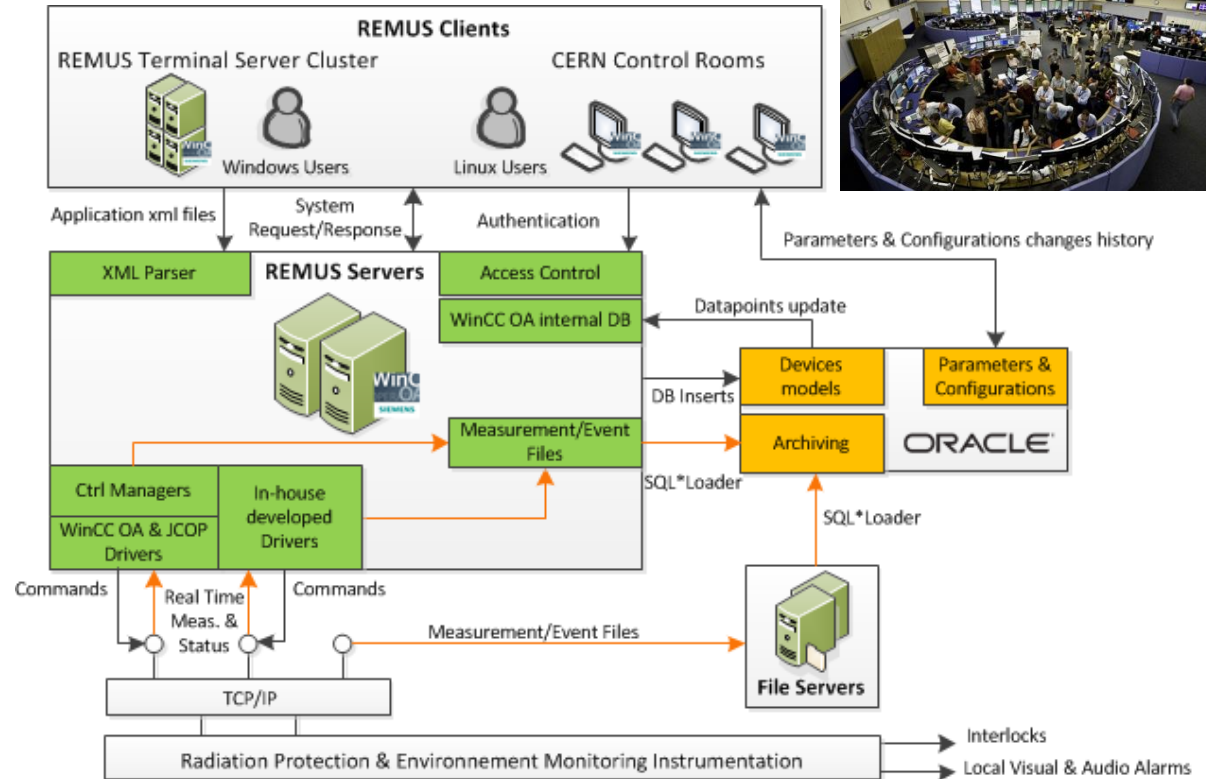
How do REMUS allows continuous Operation, Integration & Deployment?

REMUS Architecture



REMUS Architecture

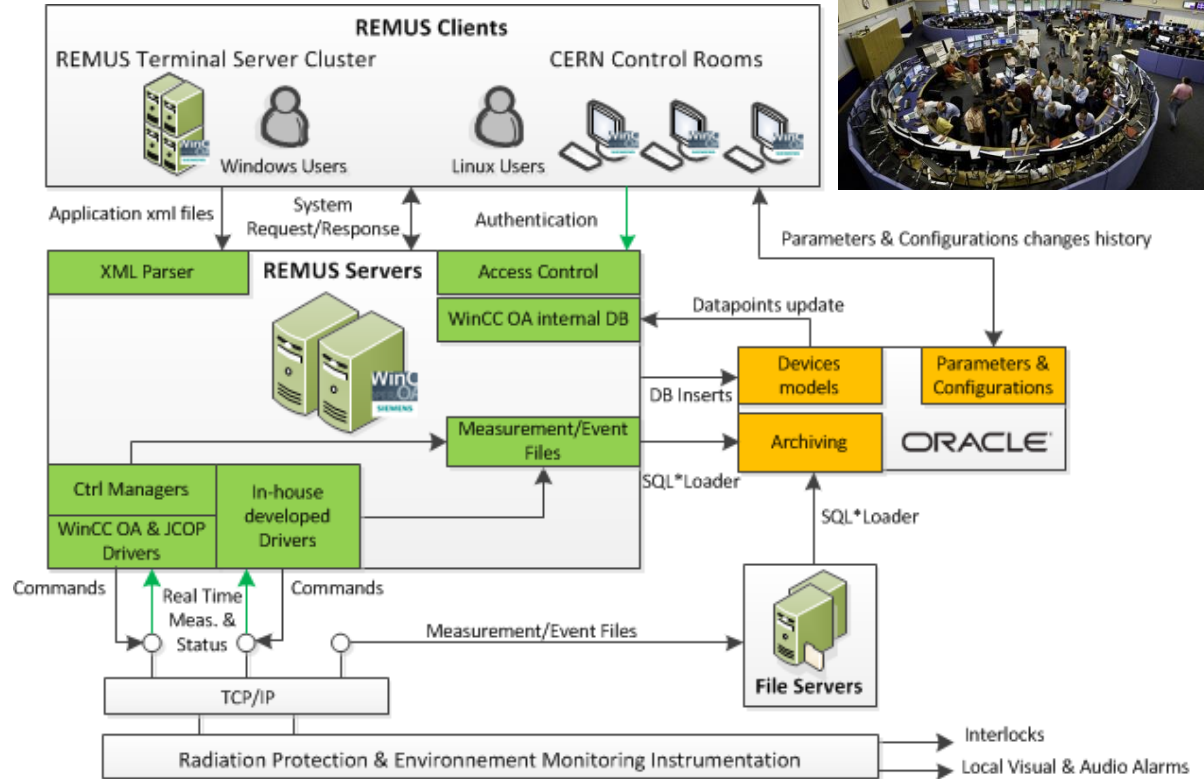
Data Acquisition



REMUS Architecture

Data Acquisition

Real time animation of Widgets & Alarm Screen

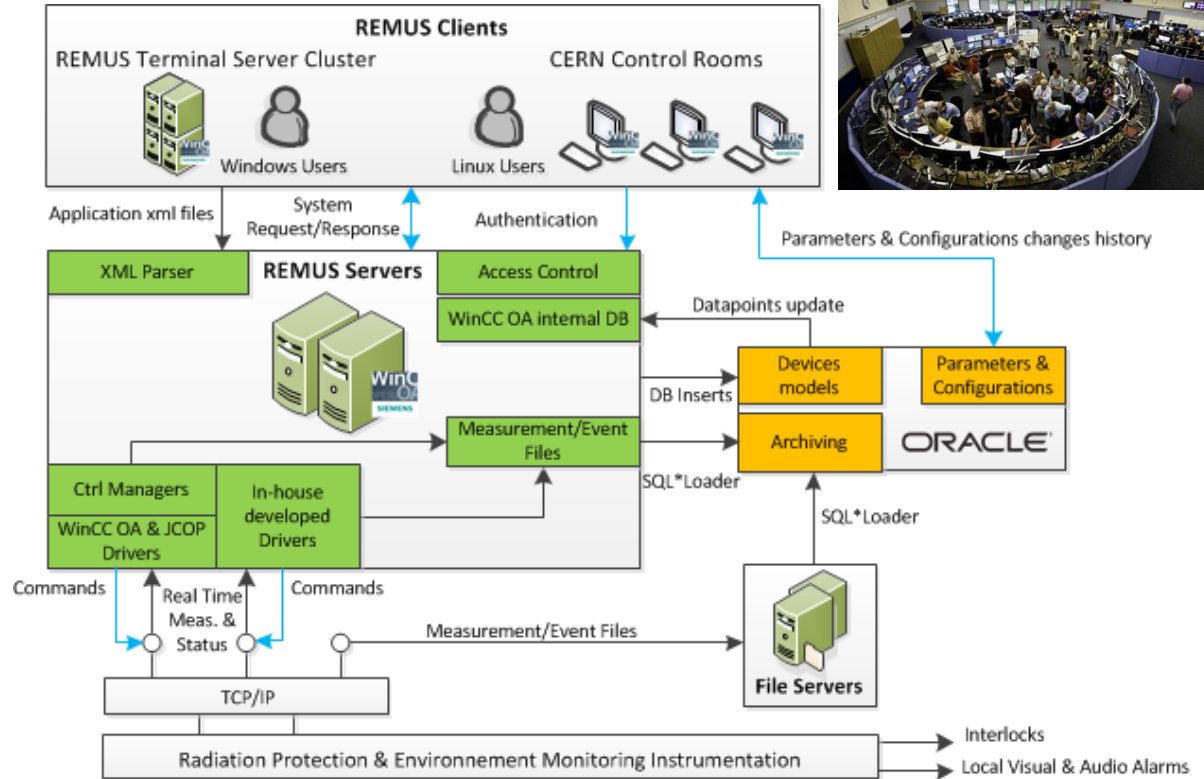


REMUS Architecture

Data Acquisition

Real time animation of
Widgets & Alarm Screen

Configuration / Parameterization



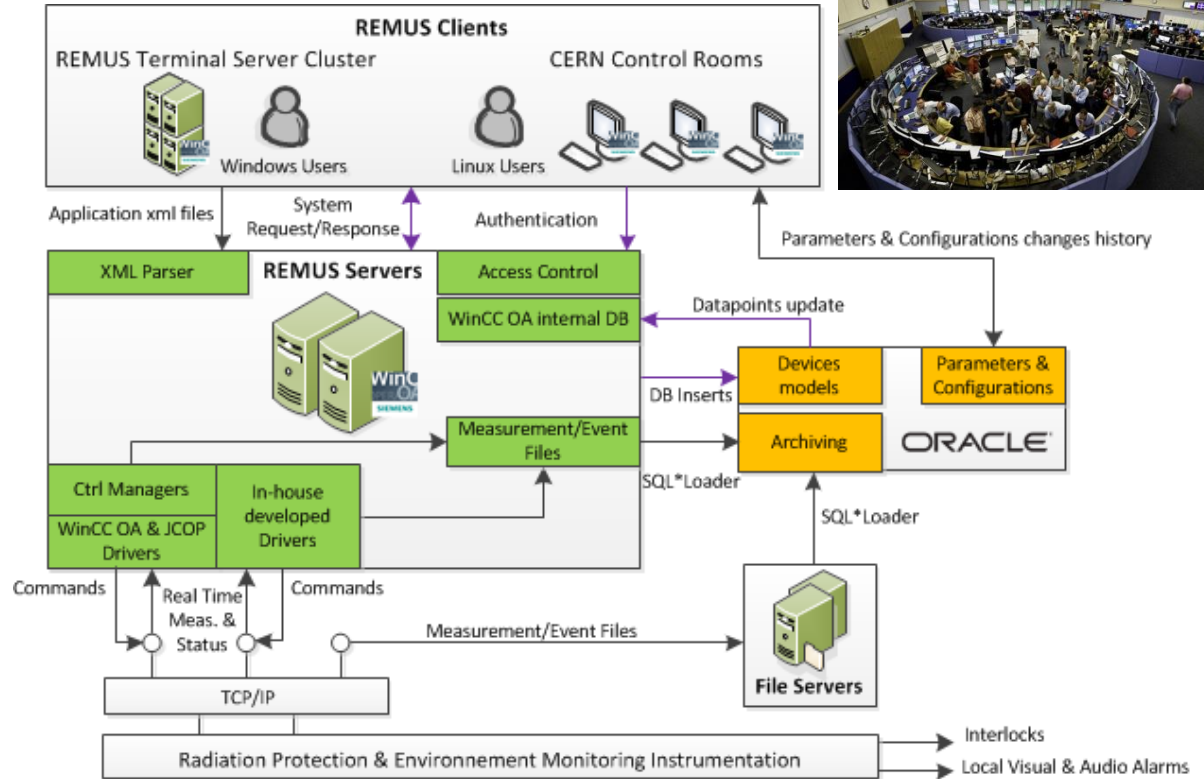
REMUS Architecture

Data Acquisition

Real time animation of Widgets & Alarm Screen

Configuration / Parameterization

Installation of a new Monitoring Station



REMUS Architecture



- Light and simple!
 - **Low maintenance** effort
 - **Easy to understand** for new developers

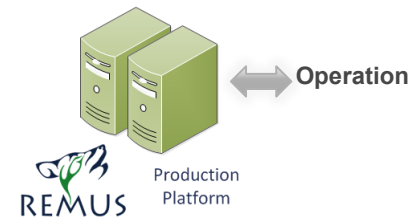
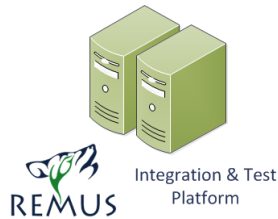
- Not CERN-dependant: Requirements to deploy REMUS in another facility:
 - 2 to 4 Linux or Windows **Servers** (2x WinCC OA + 2x File Servers if needed)
 - 1 **Oracle** Database
 - 2 **WinCC OA** licenses
 - In-house developed **Drivers** if not available in WinCC OA / JCOP framework or REMUS (**API available**)
 - In-house developed **Widgets/specific UI panels** if not yet existing (**API available**)
 - **SQL Models** of Device Types (**API available**)

REMUS Architecture

- Resilience
 - Redundancy
 - Data Acquisition **Watchdog**
 - **Buffering** of measurement in case of network outages
- Continuous integration and run-time deployment



So far (as from 2013):
Availability of the Supervision: 100%
Successful Data Acquisition: 99.8%

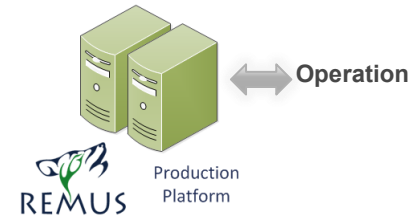
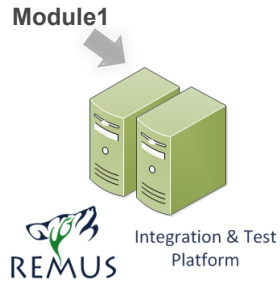


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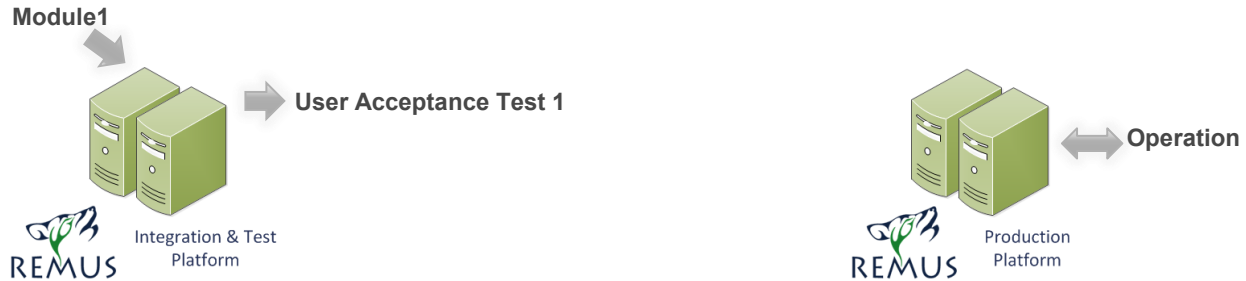


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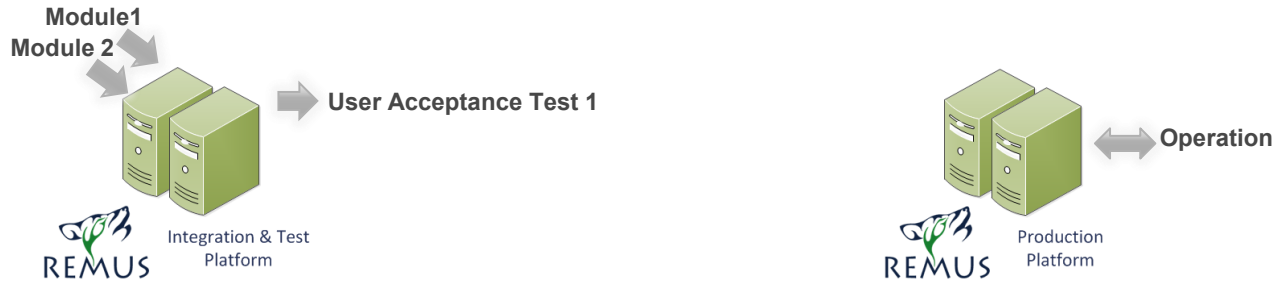


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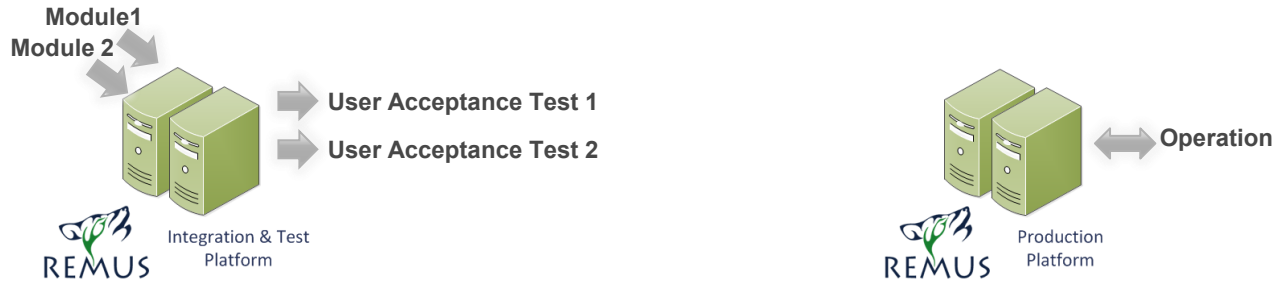


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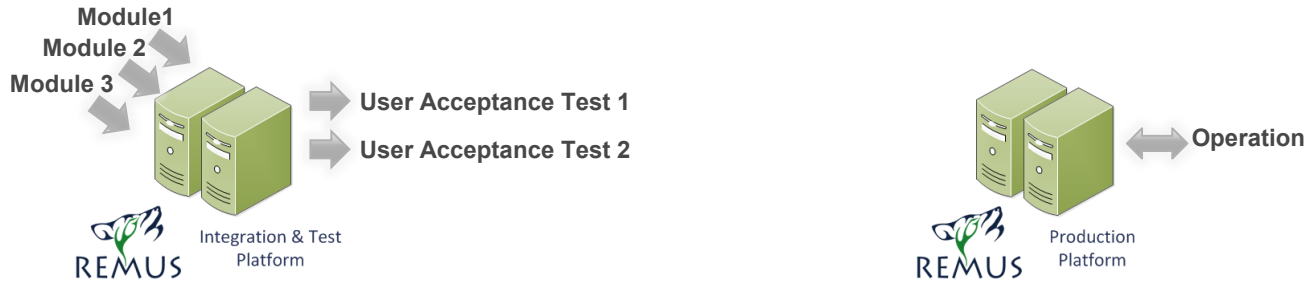


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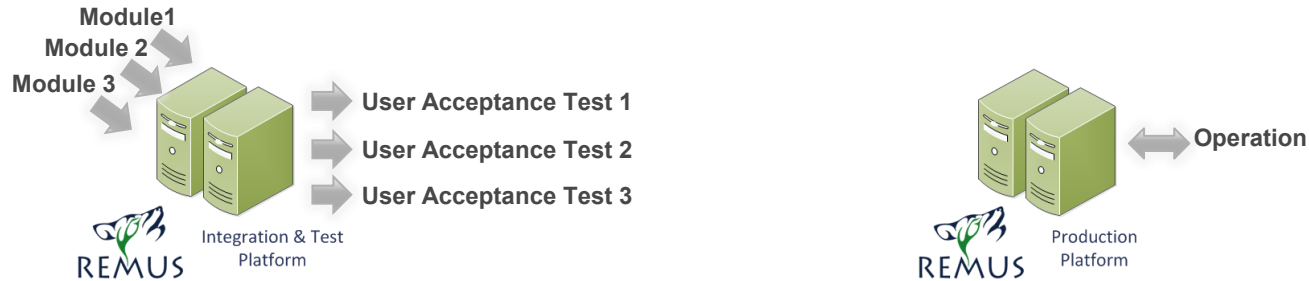


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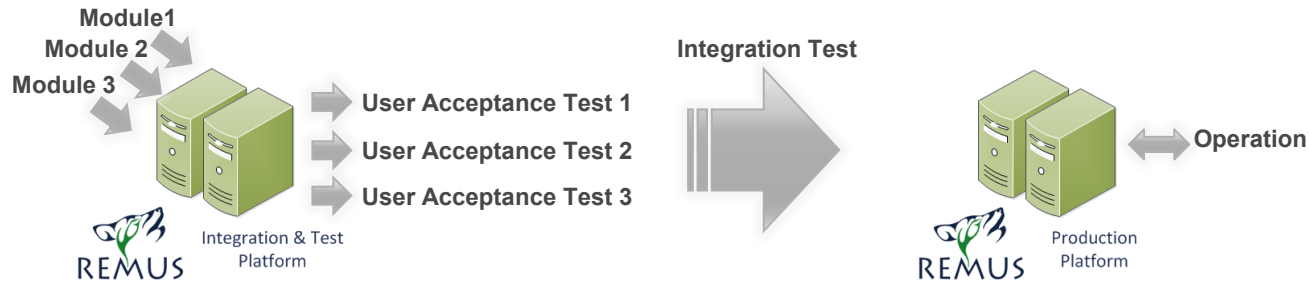


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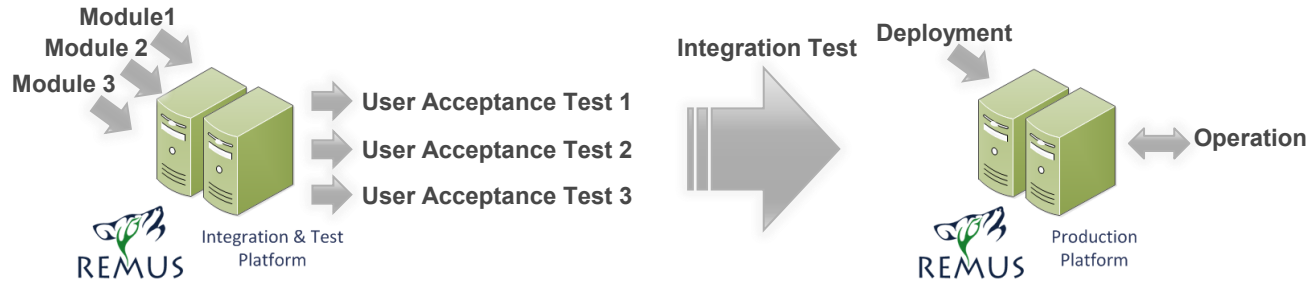


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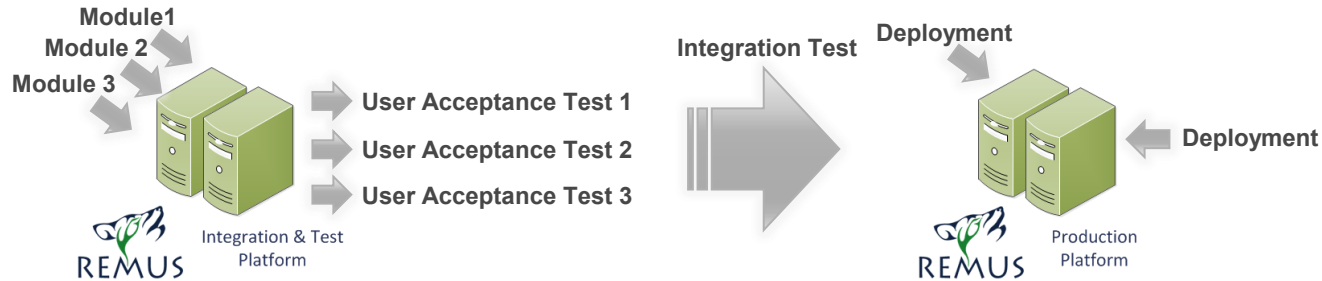


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Thank you!

Special thank to REMUS Team,
CERN HSE Unit, EN-ICE Group,
BE-CO Group, IT Department,
ICALEPCS 2015 Committees

